4. DEPARTMENT DATA FOR BIOLOGICAL SCIENCES AT HISTORICALLY BLACK COLLEGES AND UNIVERSITIES

4.1. Survey Background and Methodology

The traditional focus of the National Survey of Academic Research Instruments and Instrumentation Needs (instrumentation survey) has been the academic research units and research instruments located at a panel of 79 research-intensive universities and medical colleges. (The survey of these 79 universities will be referred to as the "panel survey" in this section.) The results of this survey for the biological sciences were presented in the preceding two chapters of this report.

In 1992 the National Institutes of Health (NIH) and the National Science Foundation (NSF) proposed that a group of historically black colleges and universities (HBCUs) be included in the instrumentation survey. The results of the survey of biological science departments and facilities at HBCUs are presented in this section. The results of the survey of biological science research instruments at HBCUs are presented in Chapter 5.

There were 105 HBCUs in 1991. Most HBCUs are considerably smaller than the research institutions that participate in the panel survey.[28] Therefore, NSF/NIH directed that the procedures used to collect data from the panel institutions in the instrumentation survey be carefully tested prior to being used to collect data from the HBCUs. In the fall of 1992, site visits were made to the biological science units in nine HBCUs. The purposes of the site visits were to pretest the instrumentation survey questionnaires and to determine the suitability of the data collection procedure.

From the pretest it was determined that the questionnaires and data collection procedures used for the panel of 79 large research institutions could be used to conduct the survey of the HBCUs. However, a number of methodological changes were made.

Of the 105 HBCUs in 1991, only 44 reported research and development (R&D) expenditures in the biological sciences.[29] An institution with no reported R&D expenditures in the biological sciences is unlikely to have biological science research instruments. Therefore, only the 44 institutions that reported R&D expenditures in the biological sciences in 1991 were included in

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[28] Although some of the HBCUs conduct more than $3 million in research and development, the minimum criterion for inclusion in the panel survey, only 56 of the HBCUs that participated in the R&D survey in 1991 reported any R&D expenditures in science and engineering. Only 44 of these reported any R&D expenditures in biology.

[29] The biological science subfields include: biochemistry, cell biology/genetics, microbiology, pathology, pharmacology, physiology/biophysics, and other biological sciences. Other biological sciences include anatomy, biometry, botany, ecology, epidemiology, nutrition, zoology, and interdisciplinary biomedical research units.

the survey. This focused the resources of the survey upon those institutions most likely to have biological research and eliminated all respondent burden at those institutions that did not.

Within each HBCU, the number of biological science units was found to be small (an estimated 1.5 units per institution). Therefore, all biological science units in the selected HBCUs were included. (In the panel survey, a sample of all biological units containing instruments over a $20,000 threshold was drawn to reduce respondent burden.)

In addition, the pretest determined that the density of costly research instruments was low: Six of the nine institutions in the pretest had less than five pieces of equipment with a purchase price of $20,000 or more, the minimum equipment purchase price criterion for inclusion in the panel survey. Therefore, the purchase price criterion of $20,000 used for the panel survey was changed to $10,000 for the selection of research instruments at HBCUs.

Because of these changes in survey methodology, direct comparisons between the biological science units and instruments at HBCUs and the biological science units and instruments at the panel of institutions would be misleading.

4.1.1. Profile of Biological Science Units at Historically Black Colleges and Universities

The population of 44 HBCUs with R&D expenditures in the biological sciences consists of 2 medical colleges and 42 non-medical colleges and universities. These institutions contain a total of 57 biological science units. In keeping with the traditional teaching mission of the HBCUs, 55 of these units are academic departments and 2 are facilities.[30] Five of these departments are part of a larger division or department of natural sciences. Only three institutions have more than one biological science unit; two of these are medical schools. Of these 57 units, 46 reported having at least 1 research instrument with a purchase price of $10,000 or more. There were a total of 293 eligible research instruments in the inventories of these units.

Three broad analytical categories are used in this report to present the unit-level data for the HBCUs: type of institutional control (private, public); highest degree awarded by the institution (doctorate-granting, non-doctorate-granting); and level of instrumentation resources ("larger" units have at least one research instrument with a purchase price of $10,000 or greater, while "smaller" units have research instruments with a purchase price of less than $10,000).

As shown in Table A, 35 of the units were located in non-doctorate-granting institutions. This is the first time that data for such institutions were ever collected in the instrumentation survey.[31] As would be expected, non-doctorate-granting institutions have fewer research resources than do doctorate-granting institutions. For example, 10 of the 11 "smaller" units (with no research

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[30] An academic department is a degree-granting unit, whereas a facility is a non-degree granting unit.

[31] There are no non-doctorate-granting institutions included in the panel of research institutions.

instruments with a purchase of $10,000 or greater) were located in non-doctorate-granting institutions.

Of the 31 units located in public institutions, 6 (19 percent) were located in doctorate-granting institutions; 5 of the 6 are "larger" units. Of the 26 units in private institutions, 16 (62 percent) were located in doctorate-granting institutions; all 16 are "larger" units.

Table A. Characteristics of the biological science units at the panel of historically black colleges and universities

	Total	Public	Private
Total	57	31	26
Doctorate-granting:	22	6	16
"Larger" units	21	5	16
"Smaller" units	1	1	0
Non-doctorate-granting:	35	25	10
"Larger" units	25	16	9
"Smaller" units	10	9	1
"Larger" units:	46	21	25
Doctorate-granting	21	5	16
Non-doctorate-granting	25	16	9
"Smaller" units:	11	10	1
Doctorate-granting	1	1	0
Non-doctorate-granting	10	9	1

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

4.1.2. Data Considerations

As previously noted, the data for this survey were collected from the entire population of HBCUs with R&D expenditures in the biological sciences, and not from a sample. Therefore, all of the data presented in this report are population values, and none are estimates.

Data were received from all 44 of the HBCU institutions in the population for a response rate of 100 percent. Of the 57 biological science departments and facilities, 55 responded to the survey (96.5 percent). Of the 293 research instruments surveyed, 215 questionnaires (73.4 percent) were completed and returned. The response rate for the questionnaire items ranged from 88.7 to 100 percent.

The variance for many of the variables in this survey is quite large due to three factors. First, the distribution of the values for many variables in this survey is highly skewed. For example, the mean unit expenditure for the purchase of research equipment is $86,339. However, 41 of the 55 units reported equipment expenditures that were less than the mean. Second, the range of

responses is often quite large. For example, the range of reported responses for equipment expenditures is from zero dollars (reported by nine units) to $1,450,000. Finally, the number of units from which data were collected is small (N=55). In the case of equipment expenditures, these three factors account for the fact that the coefficient of variation is 247. Data with a coefficient of variation this large should be used cautiously, particularly when making estimates or comparisons with other data.

4.2. Expenditures for the Purchase, Maintenance/Repair, and Operation of Scientific Research Instrumentation

4.2.1. Summary of Total Expenditures and Maintenance/Repair and Operation

The total annual expenditures for the purchase of scientific research instrumentation in the biological sciences in the HBCUs with biology R&D expenditures were approximately $4.9 million in 1993. (Table 18) The total maintenance, repair, and operation costs for instrumentation were $2.4 million, 48 percent of annual expenditures. Of the $2.4 million, $1.5 million were operation costs, and $831 thousand were for maintenance/repair of instrumentation.

Table 18. Annual expenditures for the purchase of academic research instruments and for the maintenance/repair and operation of existing academic research instruments in the biological sciences at historically black colleges and universities, by institutional control, type of institution, and size of department: 1993

[Dollars in thousands]

Institutional control, type of institution, and size of department	Maintenance/repair and operation			
	Total expenditures for purchase of instruments	Total, maintenance/ repair/ operation	Total, maintenance/ repair	Total, operation
All institutions	$4,921	$2,364	$831	$1,533
Institutional control:				
Public	2,823	904	398	506
Private	2,098	1,460	433	1,027
Type of institution:				
Doctorate-granting	3,619	1,615	541	1,074
Non-doctorate-granting	1,302	750	290	459
Size of department:				
With no instrument costing more than $10,000	459	250	72	178
With at least one instrument costing $10,000 or more	4,463	2,115	759	1,355

NOTE: Because of rounding, details may not add to totals.

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

4.2.2. Expenditures by Type of Institution

Data for research instrumentation expenditures were collected from biological science units at doctorate-granting and non-doctorate-granting institutions. The pattern for instrumentation expenditures differed based on the type of institution. Expenditures for doctorate-granting institutions were significantly higher than for the non-doctorate-granting institutions, even though there were 22 doctorate-granting units in the survey versus 35 non-doctorate-granting units. The doctorate-granting institutions' expenditures ($3.6 million) were three times more than those of non-doctorate-granting universities and colleges ($1.3 million). (Table 18) The median[32] expenditures for instrumentation were $79,814 for the doctorate-granting HBCUs and $29,000 for the non-doctorate-granting HBCUs. (Table 19)

Table 19. Median annual expenditures for the purchase of academic research instruments, and for the maintenance/repair and operation of existing academic research instruments in the biological sciences at historically black colleges and universities, by institutional control, type of institution, and size of department: 1993

[Dollars]

Institutional control, type of institution, and size of department	Median expenditures for purchase of instruments	Maintenance/repair and operation expenditures		
		Median maintenance/ repair/operation	Median maintenance/ repair	Median, operation
All institutions	$43,000	$12,000	$6,000	$2,000
Institutional control:				
Public	25,000	12,250	3,350	3,000
Private	46,300	12,000	10,000	2,000
Type of institution:				
Doctorate-granting	79,814	27,500	10,000	1,000
Non-doctorate-granting	29,000	11,250	5,500	2,500
Size of department:				
With no instrument costing more than $10,000	50,000	10,000	2,000	10,000
With at least one instrument costing $10,000 or more	37,500	12,000	10,000	1,500

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

[32] Median is used instead of mean since it reduces the effect of observations with extreme values.

The maintenance/repair and operation expenditures for the doctorate-granting and non-doctorate-granting institutions followed the same pattern as their total expenditures for research instrumentation. Median expenditures for maintenance/repair and operation were $10,000 at the doctorate-granting versus $5,500 at the non-doctorate-granting institutions.

4.2.3. Expenditures by Institutional Control

In fiscal year 1993, the annual expenditures to purchase biology research instruments for the 31 units in the public HBCUs were approximately $3 million. Corresponding expenditures for the 26 units in the private HBCUs were $2 million. The median dollar expenditures, however, reveal that private institutions' expenditures for research instrumentation ($46,300) were higher than those of the public institutions ($25,000). The maintenance, repair, and operation median expenditures for research instrumentation were higher for private HBCUs ($10,000) than the public institutions ($3,350). (Table 19) The expenditures for maintenance/repair and operation as a percentage of expenditures to purchase research instruments for the public universities and colleges were 32 percent, while for the private institutions they were 70 percent. (Table 18)

4.2.4. Expenditures by Size of Department

Data were collected from all eligible departments and facilities in the biological sciences at the HBCUs regardless of whether or not the unit had a research instrument with a purchase of $10,000 or more. As noted above, 46 units had at least 1 research instrument with a purchase price of $10,000 or more and 11 did not. For purposes of this analysis, those units with an instrument with a purchase price of $10,000 or more were categorized as "larger units." Those units with no research instrument that met this $10,000 purchase price criterion were categorized as "smaller units."

The "larger" biology units in HBCUs, on average, had more full-time faculty (11.8) and more research faculty (4.8) than did "smaller units" (9.6 full-time faculty, 1.9 research faculty).[33] They also had a median expenditure for maintenance and repair of $10,000 as compared with a median of $2,000 for "smaller" units. However, their median expenditure for the purchase of research instrumentation was lower. In 1993, "larger" units had a median expenditure for the purchase of research instruments of $37,500 and "smaller" units had a median expenditure of $50,000. (Table 19) The reasons for this difference are unclear.

4.2.5. Availability of Resources to Operate Equipment

Department chairpersons and facility directors in the biological sciences were asked to rate the availability of resources to operate current equipment in their units on a scale of 1 (excellent) to 5 (poor). The mean response was 3.8. Sixty-six percent indicated that the availability of the

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[33] Unpublished NIH survey data

resources to operate equipment was inadequate. In addition, 23 percent reported that the availability of resources was adequate, and 11 percent reported that it was adequate to excellent. (Table 20)

Table 20. Reported availability of resources to operate current instruments in the biological sciences at historically black colleges and universities, by institutional control, type of institution, and size of department: 1994

[Percent]

Institutional control, type of institution, and size of department	Reported availability of resources					Mean rating
	Excellent 1	2	Adequate 3	4	Poor 5	
All institutions	4%	7%	23%	40%	26%	3.8
Institutional control:						
Public	0	0	20	47	34	4.1
Private	8	16	28	32	16	3.3
Type of institution:						
Doctorate-granting	5	5	24	47	20	3.7
Non-doctorate-granting	3	9	23	35	29	3.8
Size of department:						
With no instrument costing more than $10,000	0	9	27	27	36	3.9
With at least one instrument costing $10,000 or more	5	7	22	43	23	3.7

NOTES: Because of rounding, percents may not add to 100.
Reported availability of resources was rated on a scale of 1 (excellent) to 5 (poor).

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

A majority of the respondents in both doctorate- and non-doctorate-granting universities and colleges rated the availability of their resources as inadequate. Sixty-seven percent of the doctorate-granting respondents rated the availability of their resources as inadequate to poor, and 64 percent of the non-doctorate-granting institutions rated them as such. Twelve percent of the respondents in the non-doctorate-granting institutions, and 10 percent of the doctorate-granting institutional respondents, reported that the availability of their resources to operate equipment was above adequate to excellent.

None of the respondents from public universities and colleges reported the availability of their resources as above adequate or excellent. Twenty-four percent of respondents from private institutions, however, reported the availability of their resources as above adequate to excellent.

4.2.6. Adequacy of Maintenance/Repair of Research Instruments

Department chairs and heads of facilities in biological sciences were asked to rate the adequacy of the maintenance/repair of research equipment in their units. To make this assessment, they were given a five-point scale that ranged from excellent (scale point 1) to poor (scale point 5). The mean rating of all respondents was 3.7. (Table 21)

Table 21. Reported adequacy of maintenance/repair of research instruments in the biological sciences at historically black colleges and universities, by institutional control, type of institution, and size of department: 1994

[Percent]

Institutional control, type of institution, and size of department	Reported adequacy of maintenance/repair					Mean rating
	Excellent 1	2	Adequate 3	4	Poor 5	
All institutions	2%	9%	31%	36%	22%	3.7
Institutional control:						
Public	0	0	16	53	30	4.1
Private	4	20	48	16	12	3.1
Type of institution:						
Doctorate-granting	5	5	38	33	19	3.6
Non-doctorate-granting	0	12	26	38	24	3.7
Size of department:						
With no instrument costing more than $10,000	0	9	27	45	18	3.7
With at least one instrument costing $10,000 or more	2	9	32	34	23	3.7

NOTES: Because of rounding, percents may not add to 100.
Perceived adequacy of maintenance/repair was rated on a scale of 1 (excellent) to 5 (poor).

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

The majority of the respondents (58 percent) reported that the maintenance/repair of their research instrumentation was below adequate. Thirty-one percent of the respondents reported that maintenance/repair was adequate. Only 11 percent of the respondents reported that it was above adequate.

Respondents' perception of the adequacy of maintenance/repair of instruments varied by institutional control. The respondents in private universities and colleges rated the maintenance/repair of instruments significantly higher than did the respondents in public schools. Seventy-two percent of the respondents in private institutions but only 16 percent of the respondents in public schools reported that the maintenance/repair of instruments was adequate or better. The mean rating for public schools was 4.1 versus 3.1 for private schools.

Fifty-two percent of the respondents in doctorate-granting institutions reported that the maintenance/repair of the instruments was inadequate or poor, while 48 percent rated it as adequate to excellent. More respondents in non-doctorate-granting institutions rated the maintenance/repair of their instruments as inadequate; 62 percent rated it as below adequate, and only 38 percent rated it as adequate or above. The mean rating for the doctorate- and non-doctorate-granting institutions was almost identical, 3.6 for doctorate-granting and 3.7 for non-doctorate-granting institutions.

The difference in the perception of the adequacy of the maintenance/repair resources between respondents in "larger" units and "smaller" units was small. More respondents in the "larger"

units (43 percent) rated the maintenance/repair of their instruments as adequate to excellent than respondents from the "smaller" units (36 percent). The mean rating for each was 3.7.

4.2.7. Sources of Funds

4.2.7.1. Federal Sources

The Federal Government provided $4.2 million of the expenditures for the purchase of academic research instrumentation in the biological sciences at HBCUs, 85 percent of the funds in 1993. (Table 22)

NIH was the single largest source of funds for the purchase of research instrumentation in the biological sciences at HBCUs in 1993. Of the $4.9 million expended for the purchase of biological science research instrumentation, NIH contributed $1.7 million, or 35 percent of the total. NSF was the second largest source of Federal funds, contributing $585 thousand or 12 percent of the total. (Table 22)

Table 22. Annual expenditures and percent distribution of expenditures for the purchase of academic research instrumentation in the biological sciences at Historically Black Colleges and Universities, by source of funds: 1993

[Dollars in thousands]

Source of funds	Dollars	Percent
Total	$4,921	100%
Federal sources, total	4,183	85
National Science Foundation	585	12
National Institutes of Health	1,700	35
Department of Defense	223	5
Department of Energy	221	4
Other	1,454	30
Non-Federal sources, total	738	15
Institution funds	292	6
State government	98	2
Industry	169	3
Other	179	4

NOTE: Because of rounding, details may not add to totals.

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

4.2.7.2. Non-Federal Sources

Non-Federal sources provided $738 thousand, 15 percent of the total funds expended for the purchase of research instrumentation in the biological sciences in 1993. The institutions themselves contributed the largest amount of non-Federal funds, $292 thousand, or 6 percent of the $4.9 million that was spent in 1993 to purchase research instrumentation. (Table 22)

Industrial sources provided 3 percent of the funds to purchase research instrumentation and State sources provided 2 percent.

4.3. Capability, Needs, Amount, and Adequacy of Academic Scientific Research Instrumentation

The biological science department chairs and heads of facilities at HBCUs were asked to assess the current stock of academic research instruments available to their researchers. This assessment included the perceived needs for research equipment in their department or facility and the adequacy of the maintenance/repair of the research equipment.

4.3.1. Needs for Research Instruments

Department chairs were asked to assess the changes in needs of their unit for research instrumentation over the past 2 years (1993–95). To make this assessment, they were given a five-point scale that ranged from substantially increased (scale point 1) to substantially decreased (scale point 5). The mean rating for all respondents was 2.0.

Seventy-six percent of the respondents in private institutions and 66 percent of respondents in public institutions reported a greater increase in need for research instruments in the period 1993–95. Thirty-one percent of the respondents in public institutions, versus 24 percent of the respondents in private institutions, reported that their needs for research instruments had remained the same. (Table 23)

Surprisingly, a larger percentage of respondents in non-doctorate-granting institutions (76 percent) reported an increased need for research instruments than in doctorate-granting institutions (62 percent). Thirty-eight percent of the respondents in the doctorate-granting institutions reported that their needs for research equipment had remained the same between 1993 and 1995, versus 21 percent of those in non-doctorate-granting institutions. Of all respondents, only 2 percent reported decreased needs over the 2-year period, and that response was limited to non-doctorate-granting public institutions.

The responses of departments heads and facility directors in the “smaller” and “larger” units were about the same. Seventy-two percent of respondents from the “smaller” units reported an increased need for research instruments versus 70 percent of those in the “larger” units.

Table 23. Reported change in instrument needs over the last two years in the biological sciences at historically black colleges and universities, by institutional control, type of institution, and size of department: 1994

[Percent]

Institutional control, type of institution, and size of department	Reported change in instrument needs					Mean rating
	Substantially increased 1	Increased 2	Remained about the same 3	Decreased 4	Substantially decreased 5	
All institutions	27%	43%	28%	2%	0%	2.0
Institutional control:						
Public	30	36	31	3	0	2.1
Private	24	52	24	0	0	2.0
Type of institution:						
Doctorate-granting	15	47	38	0	0	2.2
Non-doctorate-granting	35	41	21	3	0	1.9
Size of department:						
With no instrument costing more than $10,000	36	36	27	0	0	1.9
With at least one instrument costing $10,000 or more	25	45	28	2	0	2.1

NOTES: Reported change in instrumentation needs refers to the period 1993 to 1995.
Because of rounding, percents may not add to 100.

Reported change in instrumentation needs was rated on a scale of 1 (substantially increased) to 5 (substantially decreased).

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

4.3.2. Capability of Academic Research Instruments

HBCU department heads and facility directors in the biological sciences were asked to assess the research instrumentation in their units in terms of its capability to enable faculty investigators to pursue their major research interests. To make this assessment, they were given a five-point scale that ranged from excellent (scale point 1) to poor (scale point 5). Sixty-six percent of respondents rated their research instruments as less than adequate, 20 percent rated their research instruments as adequate for this purpose, and 14 percent rated their research instruments as above adequate. (Table 24) The overall mean rating was 3.7.

In keeping with the larger amount spent by the units in doctorate-granting institutions, (predominantly private institutions), respondents in private institutions rated their research instruments' capability to enable faculty investigators to pursue their major research higher than did respondents in public institutions. Fifty-one percent rated their research instruments as adequate or above, and 49 percent rated them as less than adequate. In contrast, only 20 percent of the respondents in public institutions rated their research instruments' capability to enable investigators to pursue their research interests as adequate. The remaining respondents (80 percent) rated this capability as less than adequate.

Table 24. Percent distribution of capability of academic research instruments to enable existing faculty investigators to pursue their major research interests in the biological sciences at historically black colleges and universities, by institutional control, type of institution, and size of department: 1994

[Percent]

Institutional control, type of institution, and size of department	Capability of instruments to enable research					Mean rating
	Excellent 1	2	Adequate 3	4	Poor 5	
All institutions	0%	14%	20%	44%	22%	3.7
Institutional control:						
Public	0	0	20	46	34	4.1
Private	0	31	20	41	8	3.3
Type of institution:						
Doctorate-granting	0	18	38	39	5	3.3
Non-doctorate-granting	0	12	9	47	33	4.0
Size of department:						
With no instrument costing more than $10,000	0	9	9	36	45	4.2
With at least one instrument costing $10,000 or more	0	16	23	45	16	3.6

NOTES: Because of rounding, percents may not add to 100.
Capability of research instruments was rated on a scale of 1 (excellent) to 5 (poor).

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

Respondents in doctorate-granting universities and colleges were more likely than respondents in non-doctorate-granting colleges and universities to rate the capability of their research instruments as adequate or above; 56 percent for respondents in doctorate-granting universities and colleges and 24 percent for respondents in non-doctorate-granting colleges and universities. The mean rating of respondents in doctorate-granting schools was 3.3; the mean rating of respondents in non-doctorate-granting colleges and universities was 4.0. (Table 24)

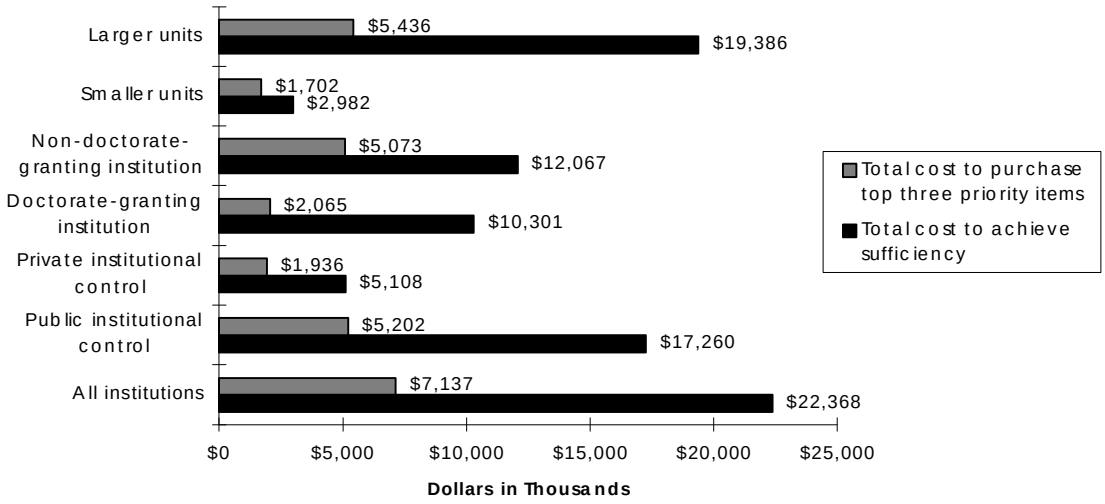
Department heads and facility directors of “smaller” units (i.e., all instruments less than $10,000) expressed a greater dissatisfaction with the capability of their research instruments to enable existing faculty investigators to pursue their research interests than did other respondents. Eighty-one percent of the respondents in “smaller” units reported that the capability of their instruments was below adequate, 9 percent rated it as adequate, and another 9 percent rated it as above adequate. Sixty-one percent of the respondents in “larger” units reported that the capability of their instruments was below adequate, 23 percent rated it as adequate, and 16 percent rated it as above adequate.

4.3.3. Inadequate Equipment and Total Cost to Achieve Sufficiency

HBCU department heads and facility directors in the biological sciences who rated their research instruments as inadequate or poor in enabling existing faculty investigators to pursue their major research interests were asked to estimate the cost to acquire sufficient equipment that would fully support their existing faculty.

Sixty-five percent of all the respondents reported that the overall capability of their research equipment was inadequate to poor. These respondents reported that it would take $22.4 million to achieve sufficiency; $17.3 million was reported by the 31 units at public institutions and $5.1 million was reported by the 26 units at private universities and colleges. (Table 25, Figure 18)

Figure 18. Total cost of instrumentation needed by respondents who reported inadequate instrumentation for faculty investigators (HBCU): 1994



Source: Academic Research Instrumentation & Instrumentation Needs in the Biological Sciences: 1994

Table 25. Percent of respondents who reported their research instruments were not adequate to enable faculty to pursue their major research interests, and the estimated cost to acquire sufficient research instruments to support faculty fully in the biological sciences at historically black colleges and universities, by institutional control, type of institution, and size of department: 1994

[Dollars in thousands]

Institutional control, type of institution, and size of department	Percent reporting inadequate equipment	Total cost to achieve sufficiency	Median cost per unit	Mean cost per unit
All institutions	65%	$22,368	$399	$600
Institutional control:				
Public	80	17,260	499	705
Private	49	5,108	175	399
Type of institution:				
Doctorate-granting	44	10,301	150	1,073
Non-doctorate-granting	79	12,067	500	436
Size of department:				
With no instrument costing more than $10,000	82	2,982	300	331
With at least one instrument costing $10,000 or more	62	19,386	500	685

NOTES: Data are for the 65 percent of the respondents who reported on a scale from 1 (excellent) to 5 (poor), that the overall capability of research equipment to enable existing faculty investigators in their unit to pursue their major research interests was inadequate or poor (a score of 4 or 5).

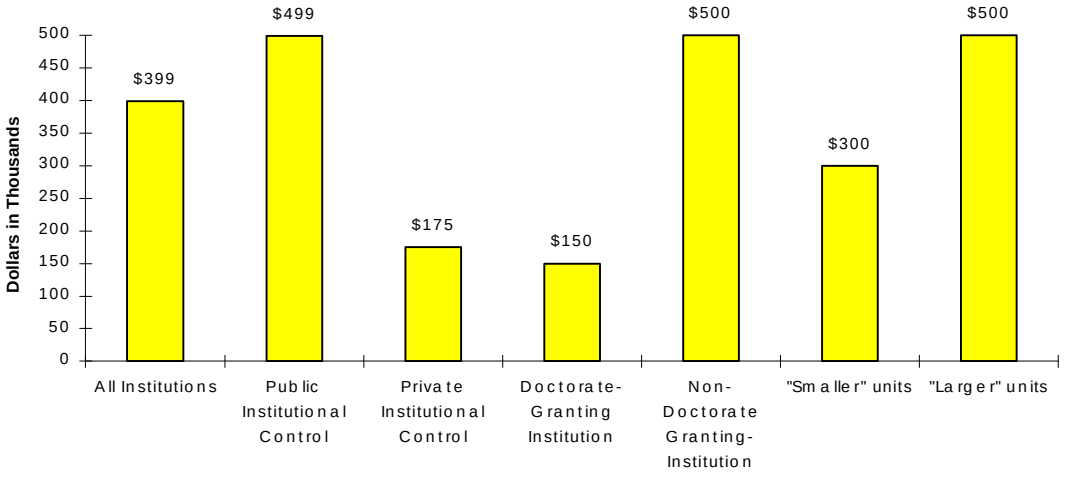
Because of rounding, details may not add to totals.

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

Respondents from the 22 doctorate-granting institutions reported that it would require $10.3 million to achieve sufficiency in their research instruments, while the 35 non-doctorate-granting institutions' respondents reported that it would require $12.1 million to do so. Respondents from the 11 "smaller" units reported $3 million would be required for this purpose, and the 46 "larger" units reported $19.4 million.

In terms of median cost per unit to achieve sufficiency, the greatest difference was reported between respondents from doctorate-granting and from non-doctorate-granting universities and colleges. Respondents from doctorate-granting institutions reported that they would require $150 thousand to acquire sufficient research instruments to support their faculty, while respondents from non-doctorate-granting institutions reported that $500 thousand would be required. (Table 25, Figure 19)

Figure 19. Median estimated cost of research instruments required to enable faculty to pursue their major research interests (HBCU): 1994



Source: Academic Research Instrumentation & Instrumentation Needs in the Biological Sciences: 1994

4.3.4. High-Priority Instrumentation

Department chairs and heads of facilities in the biological sciences were asked to identify the three research instruments with a purchase price of $10,000 or more that were the "topmost priorities" in their units. They were asked to list these items in priority order, to estimate the purchase price for each, and to state the reason each was needed.

The total cost to purchase the three top-priority instruments for all institutions was $10.2 million. (Table 26) The purchase price reported for the 22 units at doctorate-granting institutions was $4.3 million, versus $6 million for the 35 units in non-doctorate-granting institutions.

Respondents from doctorate-granting institutions reporting adequate instrumentation gave a median value of $165,000 for their three top-priority instruments, versus a median value of $175,000 given by respondents reporting inadequate instrumentation. However, respondents from non-doctorate institutions reporting adequate instrumentation gave a median cost of $82,000 for the three top-priority items, versus $207,500 given by respondents reporting inadequate instrumentation.[34]

[34] Unpublished NIH survey data

Table 26. Total cost to purchase the three top priority items requested in the biological sciences at historically black colleges and universities, by institutional control, type of institution, and size of department: 1994

[Dollars in thousands]

Institutional control, type of institution, and size of department	All instruments	Computers and data handling instruments	Chromato-graphs and spectro-meters	Microscopy instruments	Bioanalytical instruments	Other instruments
All institutions	$10,177	$495	$3,002	$2,593	$3,545	$543
Institutional control:						
Public	5,846	231	1,603	1,910	1,747	356
Private	4,330	263	1,399	683	1,798	187
Type of institution:						
Doctorate-granting	4,268	237	1,410	840	1,542	240
Non-doctorate-granting	5,909	258	1,592	1,753	2,003	304
Size of department:						
With no instrument costing more than $10,000	1,815	50	507	638	576	45
With at least one instrument costing $10,000 or more	8,362	445	2,495	1,955	2,969	498

NOTE: Because of rounding, details may not add to totals.

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

The top-priority research instruments were tabulated into five major categories: chromatographs/spectrometers; microscopes; bioanalytical instruments; computers; and other instrumentation such as lasers and electrochemistry equipment. Of these, bioanalytical instruments were the high-priority research instruments most frequently mentioned by the respondents in the biological sciences. This category includes cell sorters, cell counters, cytometers, centrifuges, elemental analyzers, and carbohydrate analyzers. Thirty-five percent of the respondents identified bioanalytical instruments as their first priority, 33 percent identified bioanalytical instruments as their second priority, and 36 percent mentioned them as their third priority. (Table 27).

Table 27. Percent distribution of requested instruments in the biological sciences at historically black colleges and universities, by type of instrument requested and level of priority: 1994

[Percent]

Type of instrument requested	First Priority	Second Priority	Third Priority
Total, all instruments	100%	100%	100%
Computers and data handling instruments	14	6	14
Chromatographs and spectrometers	29	31	22
Microscopy instruments	22	24	4
Bioanalytical instruments	35	33	36
Other instruments	0	6	23

NOTE: Because of rounding, percents may not add to 100.

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

4.3.5. Total Estimated Purchase Price of Top-Priority Items

The total estimated purchase price of all categories of top-priority items was $3.6 million. The item category with the highest total cost was bioanalytical instruments ($1.3 million), followed by chromatographs/spectrometers and microscopy instruments (both $1 million), and finally computers and data handling instruments ($254 thousand). (Table 28)

Table 28. Total cost to purchase the top priority item requested in the biological sciences at historically black colleges and universities, by institutional control, type of institution, and size of department: 1994

[Dollars in thousands]

Institutional control, type of institution, and size of department	Major type of instrument					
	All instruments	Computers and data handling instruments	Chromato-graphs and spectrometers	Microscopy instruments	Bioanalytical instruments	Other instruments
All institutions.....	$3,574	$254	$1,037	$1,009	$1,274	$0
Institutional control:						
Public	2,106	174	484	971	478	0
Private	1,468	80	553	39	796	0
Type of institution:						
Doctorate-granting.....	1,415	108	570	195	543	0
Non-doctorate-granting..	2,159	146	468	814	731	0
Size of department:						
With no instrument costing more than $10,000	815	50	100	440	225	0
With at least one instrument costing $10,000 or more.....	2,759	204	937	569	1,049	0

NOTE: Because of rounding, details may not add to totals.

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

Doctorate-granting institutions' greatest need was for chromatographs ($570,000), followed by bioanalytical instruments ($543,000) and microscopy instruments ($195,000). The respondents from non-doctorate-granting institutions reported the highest need, in terms of total cost, for microscopy instruments ($814,000), followed by bioanalytical instruments ($731,000), and chromatographs/spectrometers ($418,000).

The median estimated price of the highest priority research instruments was $50,000. (Table 29) The highest median cost was for chromatographs and spectrometers ($60,000), followed by microscopy instruments and bioanalytical instruments, both at $50,000.

Table 29. Median cost to purchase the top priority item requested and percent of respondents in the biological sciences at historically black colleges and universities requesting that item, by institutional control, type of institution, and size of department: 1994

Institutional control, type of institution, and size of department	Major type of instrument											
	All instruments		Computers and data handling instruments		Chromatographs and spectrometers		Microscopy instruments		Bioanalytical instruments		Other instruments	
	Median cost	Percent of respon-dents	Median cost	Percent of respon-dents	Median cost	Percent of respon-dents	Median cost	Percent of respon-dents	Median cost	Percent of respon-dents	Median cost	Percent of respon-dents
All institutions	$50,000	100%	$25,000	15%	$60,000	29%	$50,000	21%	$50,000	34%	$0	0%
Institutional control:												
Public	50,000	100	25,000	18	70,000	17	60,000	35	45,000	30	0	0
Private	50,000	100	40,000	13	42,500	43	35,000	5	50,000	39	0	0
Type of institution												
Doctorate-granting	45,000	100	25,000	15	120,000	25	32,500	21	50,000	40	0	0
Non-doctorate-granting	50,000	100	35,500	16	55,000	31	95,000	22	47,500	31	0	0
Size of department:												
With no instrument costing more than $10,000	50,000	100	50,000	9	50,000	18	220,000	18	32,500	55	0	0
With at least one instrument costing $10,000 or more	50,000	100	23,000	17	60,000	32	47,500	22	50,000	29	0	0

NOTE: Because of rounding, percents may not add to 100.

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

4.3.6. Optimal Price Range of Federal Funding

When asked the price range where Federal funding would be most beneficial to the research in their departments or facilities, the majority of the respondents (67 percent) reported that their greatest need was for items with a purchase price of $50,000 or more. (Table 30) By type of institution, 57 percent of the doctorate-granting institutions reported that their greatest need was for equipment with a purchase price of $50,000 or more; 32 percent specified the $100,000–499,999 range. Among the non-doctorate-granting institutions, 74 percent reported the need for equipment over $50,000, 23 percent specified the $100,000–499,999 range.

By institutional control, 70 percent of respondents from public institutions reported that their greatest need was for equipment with a purchase price of $50,000 or more; 26 percent reported a specific need for the $100,000–499,999 price category. Sixty-four percent of the respondents in private institutions reported a need for equipment with a purchase price of $50,000 or more; 27 percent reported a specific need in the $100,000–499,999 category.

Table 30. Percent distribution of the price range of instruments for which increased Federal instrumentation funding would be most beneficial to biological science units at historically black colleges and universities, by institutional control, type of institution, and size of department: 1994

[Percent]

Institutional control, type of institution, and size of department	Price range most beneficial						
	Under $10,000	$10,000-$19,999	$20,000-$49,999	$50,000-$99,999	$100,000-$499,999	$500,000-$999,999	$1,000,000 and over
All institutions	2%	7%	24%	22%	27%	13%	5%
Institutional control:							
Public	0	10	20	17	26	20	7
Private	4	4	28	29	27	4	4
Type of institution:							
Doctorate-granting	5	14	24	20	32	5	0
Non-doctorate-granting	0	3	24	24	23	18	9
Size of department:							
With no instrument costing more than $10,000	0	18	18	9	36	18	0
With at least one costing $10,000 or more	2	5	25	25	24	11	7

NOTE: Because of rounding, percents may not add to 100.

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994